

R E M A R K S

This application has been amended in a manner that is believed to place it in condition for allowance at the time of the next Official Action.

In the outstanding Official Action, claims 1-14 were rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. This rejection is respectfully traversed.

It is believed to be apparent that claims 1-14 have been amended in a manner that obviates the contention of the outstanding Official Action that claims 1-14 were indefinite for reciting the term "appropriate".

Applicants respectfully submit that the meaning of the term "substantially near" would be definite to one skilled in the art, particularly in the context of the figures and discussion set forth in the present specification on page 8. The present specification clearly describes the separation of the fluidised bed into two different layers or phases. This is due to the density of the magnetite particles decreasing upon complex formation with beta-carotene. Accordingly, as explained at the beginning of page 9, the beta-carotene can be desorbed from the magnetite in the top phase by changing the flow into the inlet at (103) from brine to a desorption solvent. Therefore, in order to recover the beta-carotene, one skilled in the art would

appreciate that, because the compound is desorbed from the magnetite in the top phase of the fluidised bed, collection of the washed solution from substantially near the top of, or above, the fluidised bed of magnetite, is desired. Similarly, in order to collect the magnetite-beta-carotene complex from the fluidised bed, it is clear from the third paragraph on page 8 of the present specification that it is desirable that the particles be collected from substantially near the top of the fluidised bed.

Accordingly, Applicants submit that claims 4 and 6 are not indefinite in scope. In fact, Applicants believe that the scope of these claims and recitations therein would be readily understood by one skilled in the art. Thus, it is believed that claims 4 and 6 are definite to one of ordinary skill in the art.

The Official Action rejected claims 13 and 14 under 35 U.S.C. 102(b) as allegedly being anticipated by CURTAIN et al. This rejection is respectfully traversed.

Claim 14 is directed to a crystalline-metallic-ore-fat-soluble-compound complex obtained using a method of the present invention. An example of such a complex is the magnetite-beta-carotene complex prepared in examples 1 to 3. In contrast, Curtain et al. describe the preparation of *Dunaliella salina* complexes. The *Dunaliella* cells are absorbed onto a hydrophobic adsorbent. Beta-carotene is then recovered by treating the cell-adsorbent complex with a solvent capable of damaging the cell membrane, thereby allowing the beta-carotene to be extracted.

Accordingly, there is no disclosure of the crystalline-metallic-ore-fat-soluble-compound complex of the present invention in CURTAIN et al. In addition, as explained in further detail below, it is respectively submitted that there is no motivation or suggestion in CURTAIN et al. that would lead one skilled in the art to produce the crystalline-metallic-ore-fat-soluble-compound complex of the present invention.

In the outstanding Official Action, claims 1 and 12 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over CURTAIN et al. in view of WEITZEN et al. This rejection is traversed.

CURTAIN et al. provide a method for harvesting *Dunaliella* from suspensions in brines containing sodium chloride at a concentration of 3M or above. With reference to CURTAIN et al., this publication is based on the observation that the cell membrane of *Dunaliella* becomes hydrophobic when the cells are in contact with solutions of sodium chloride having a concentration of about 3M or higher. As a result of this induced hydrophobicity, the whole cells may be adsorbed onto other hydrophobic surfaces. Accordingly, contacting *Dunaliella* cells in a brine with a salt concentration of 3M or greater in the presence of a hydrophobic material will result in the cells being adsorbed onto the hydrophobic material. In this way, whole cells may be separated from a bulk solution. CURTAIN et al. explain that, at lower concentrations of sodium chloride, the surface of

the cell membrane is dominated by polar groups. A cell surface of this nature will be hydrophilic and the cells will not adsorb or remain adsorbed onto a hydrophobic surface.

CURTAIN et al. provides examples of a whole range of hydrophobic materials, including polyester fiber, teflon fiber, and acrylic fiber. In addition, CURTAIN et al. utilize a variety of other materials, such as glass wool and magnetite, which have been silanised. A process of this nature involves treating the material with silanes which are waterproofing chemicals that coat the material with a hydrophobic surface.

In contrast to the method of CURTAIN et al., which is limited to salt concentrations of 3M or greater, the present invention may be applied irrespective of salt concentration. In addition, as explained in the first full paragraph on page 6, the magnetite in the present invention advantageously performs the dual purpose of disrupting cell membranes and absorbing beta-carotene. Furthermore, the present invention utilizes the bulk density of magnetite in a fluidised bed. This permits the automated decantation of magnetite particles loaded with beta-carotene from the system while retaining unloaded particles. Moreover, the process of the present invention involves the adsorption and desorption of beta-carotene within the same system. CURTAIN et al. necessarily involves the separation of the adsorbed material. Finally, the present invention advantageously enables the collection of beta-carotene from

brines containing *Dunaliella* cells without the beta-carotene including associated contaminants such as triterpenoids and other lipids. These contaminations are often present in beta-carotene obtained according to the method of CURTAIN et al.

Accordingly, it is submitted that the present invention is distinct and non-obvious from CURTAIN et al.

In an effort to remedy the deficiencies of CURTAIN et al., the Official Action cites WEITZEN et al. With respect to WEITZEN et al., this publication is directed to magnetic ballasting of solid sorbents and the application of such sorbents to the removal of heavy metal ions from process streams containing high levels of suspended solids. The Official Action alleges that it would have been obvious to one skilled in the art to combine the teachings of CURTAIN et al. and WEITZEN et al. However, it is believed that the Official Action fails to identify any suggestion in the cited references as to the desirability of the combination. Thus it is believed that the Official Action fails to meet its burden in rendering the claimed invention obvious.

Even if one skilled in the art were to combine the teachings of CURTAIN et al. and WEITZEN et al, it is submitted that one skilled in the art would not obtain the present invention. WEITZEN et al. seeks to improve known features of fluidised beds by modifying known sorbent materials. WEITZEN et al. achieve this by increasing their particle density by

combining them with metal alloys. The increase in sorbent particle density allegedly improves the fluidised bed performance by increasing the settling velocity of the particles. Thus, it is believed that the present invention is distinct and nonobvious from the invention described by WEITZEN et al.

The present invention exploits settling velocity changes in an entirely different way to that described by WEITZEN et al. In the present invention, magnetite particles absorb beta-carotene and become fractionally less dense as a result. Because they are less dense, they have a reduced settling velocity and migrate to the top of the fluidised bed. This establishes a gradient from the bottom of the fluid bed, wherein unloaded magnetite particles have a maximum density, to the top of the bed, where particles are fully loaded and have the least density. This discovery enables the continuous and exclusive removal of beta-carotene loaded particles. In contrast, WEITZEN et al. increase particle density prior to the particles entering the bed.

Moreover, the present invention does not modify the density of a known sorbent particle. The present invention utilizes the inherent density of magnetite coupled with the surprising and undescribed properties of the mineral being its natural capacity to adsorb beta-carotene and its capacity to rupture the cells of *Dunaliella salina*.

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Thus, it is respectfully submitted that one skilled in the art would lack the motivation and necessary teaching from CURTAIN et al. and WEITZEN et al. to render the present invention obvious.

In view of the present amendment and the foregoing remarks, therefore, it is believed that this application has been placed in condition for allowance. Allowance and passage to issue on this basis are respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

Page 9, the paragraph, beginning on line 7, has been amended as follows:

--It can be clearly seen that by using a number of vessels such as (101), connected in series such that the outlet (106) of one is connected to the inlet (103) of the next vessel in the series, any number of vessels can be connected to each other. If both the inlet and the outlet are connected via a manifold which can feed either brine or desorption solvent into the vessel, then a continuous process cycle of adsorption/[desportion]desorption/[adsorbition]adsorption is possible.--

Page 10, the paragraph, beginning on line 27, bridging pages 10 and 11, has been amended as follows:

--A culture of *Dunaliella salina* was grown in outdoor ponds containing sodium chloride at a concentration of 60 g per litre (approximately 1 M) and magnesium chloride at 60g per litre (approximately [1] 0.6 M). When the culture had attained a beta carotene concentration of 11mg per litre, the culture was pumped into the bottom of a vertical perspex cylinder of 100mm diameter at a rate of 1.4 litre per minute. When the cylinder became filled with liquid, 1,600g of magnetite (120 mesh) was introduced into the top of the cylinder. The magnetite moved towards the bottom of the cylinder but became suspended within the cylinder

as the fluidised bed which maintained a height of 800 mm. When the fluidised bed became stable, the culture which passed through the bed to the top of the cylinder was sampled and the beta carotene concentration was measured and found to be 0.07 mg per litre. The culture medium emerging from the top of the column was examined under a microscope. There were no intact algal cells observed, however cellular debris, comprising mostly broken cell membranes, and halobacteria were observed.--

Page 11, the paragraph, beginning on line 24, bridging pages 11 and 12, has been amended as follows:

--A culture of *Dunaliella salina* was grown in outdoor ponds containing sodium chloride at a concentration of 90g per litre (approximately 1.5 M) and magnesium chloride at 90g per litre (approximately [1.5]1.0 M). When the culture had attained a beta carotene concentration of 14mg per litre, the culture was pumped into the bottom of a vertical perspex cylinder of 100mm diameter at a rate of 1.65 litre per minute. When the cylinder became filled with liquid, 1,600g of magnetite (120 mesh) was introduced into the top of the cylinder. The [magnetic] magnetite moved towards the bottom of the cylinder but became suspended within the cylinder as a fluidised bed which maintained a height of 800mm. When the fluidised bed became stable, the culture which passed through the bed to the top of the cylinder was sampled and the beta carotene concentration was measured and found to be 0.06 mg per litre.--

IN THE CLAIMS:

Claim 1 has been amended as follows:

--1. (amended) A method of extracting fat-soluble compounds from aqueous solutions including the steps:
providing an aqueous solutions in which a fat-soluble compound is present;
providing a bed of crystalline metallic ore particles held in a [appropriate] vessel;
applying the aqueous solution to the bed of crystalline metallic ore particles substantially near the bottom of the bed at a rate sufficient to form and maintain a fluidised bed of crystalline metallic ore particles;
allowing the fat-soluble compound to attach to the crystalline metallic ore particles to form a crystalline-metallic-ore-fat-soluble-compound complex;
providing a wash solution;
contacting the wash solution with the crystalline-metallic-ore-fat-soluble-compound complex to desorb the fat-soluble compound from the complex;
collecting the wash solution containing the fat-soluble compound;
and
isolating the fat-soluble compound from the wash solution.--

Claim 4 has been amended as follows:

--4. (twice amended) A method as claimed in claim 1 wherein the wash solution is contacted with the crystalline-

metallic-ore-fat-soluble-compound complex by applying the wash solution to the fluidised bed of crystalline metallic ore particles substantially near the bottom of the fluidised bed and at a rate sufficient to maintain the bed in a fluidised state and the resultant wash solution containing the fat-soluble compound is collected from substantially near the top of, or above, the fluidised bed of crystalline metallic ore particles.--